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(54) Name of the Invention: Packaging Material

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[Note: Names, addresses, company names and brand names are translated in the most common manner. Japanese language does not have singular or plural words unless otherwise specified by a numeral prefix or a general form of plurality suffix.]

Description of the Invention

1. Name of the Invention

Packaging Material

2. Scope of the Claims

(1) Packaging material that is formed from an electret material that has a flat surface part, which carries an electric charge with mutually different polarities on its back and front surfaces.

(2) Packaging material according to the above reported Claim paragraph 1 where the density of the surface electric charge per each surface that is charged on the flat surface part is at least 1 x 10^{-11} Coulomb/cm2 or higher.

(3) Packaging material according to the above reported Claim paragraphs 1 or 2 where the electret material is formed from a sheet shaped material that can be selected from films made from resin materials, nonwoven fabrics, paper, woven materials etc.

(4) Packaging material according to the above reported Claim paragraphs 1 or 2 where the electret material is formed from a molded structure material comprised of resin.

(5) Packaging material according to the above reported Claim paragraphs 3 or 4 where the resin is a material that can be selected from polyolefin type resin, polyester type resin, fluorine containing type resin, polyvinyl chloride type resin, polyamide type resin, polyacrylic type resin.

(6) Packaging material according to the above reported Claim paragraph 3 where the electret material is formed from a resin film, and where the carbon gas permeability of the above resin film is within the range of 500 ~ 350,000 cc/m2.24 hr.atm, the oxygen gas permeability is within the range of 100 ~ 35,000 cc/m2.24 hr.atm, and it is used in the packaging of raw (unprocessed) and fresh items.

(7) Packaging material according to the above reported Claim paragraph 3 or Claim paragraph 6 where the electret material is formed from a resin film, and where the moisture permeability of the above resin film is within the range of 5 ~ 700 g/m2.24 hr.atm, and it is used in the packaging of raw (unprocessed) and fresh items.

(8) Packaging material according to the above reported Claim paragraph 3 where the electret material is formed from a resin film, and where the oxygen gas permeability is within the range of 5 ~ 200 cc/m2.24 hr.atm, and it is used in the packaging of meat food items.

(9) Packaging material according to the above reported Claim paragraph 3 where the electret material is formed from a resin film, and where numerous pores are opened in the above resin film and it is used in the packaging of raw (unprocessed) and fresh items.

3. Detailed Explanation of the Invention

[Technical Field of the Invention]

The present invention is ah invention about a packaging material, and then in more details, the present invention is an invention about a packaging material that maintains the original freshness of the packaged items for prolonged period of time.

[Previous Technology]

In the past, in order to maintain the freshness of the raw (unprocessed) items like vegetables or fruits etc., in supermarkets or food product stores, the method of packaging using resin films like polyvinylidene chloride type resin, or polyethylene type resin films, has been used. In the case of the packaging using these resin films, certain results have been achieved in order to control the water vapor generation and together with that to prevent the soiling from the outside and the decrease of the value of the product that is being sold.

However, in the case of the packaging method by using this resin film, it is only a method where simply the water evaporation is prevented and the soiling is prevented, and it has no results with respect to the control of the cell generation, like the bacteria or mold, etc., that multiply inside the packaged material, and because of that if the items are stored for approximately 1 week or more, it has not been possible to prevent the generation of mold etc., in the packaged items. Also, in the case of vegetables or fruits, etc., fresh items, there is color fading and color change, and the packaging method has not been effective in preventing this color fading or color change.

Consequently, in the case of the resin film packaging methods used according to the previous technology, there have been limitations at the time when it has been necessary

to maintain the freshness for a prolonged period of time or to prevent the generation of mold.

[Problems Solved by the Present Invention]

The goal of the present invention is to break the above-described limitations according to the previous technology and then it is to suggest a packaging material that can maintain the original degree of freshness for a prolonged period of time.

Then in more details, the goal of the present invention is to suggest a packaging material for not only vegetables, or fruits etc., raw (unprocessed) items, but also for harvested plants etc., numerous types of packaged items, that is a packaging material that can maintain the original freshness of the packaged items for a prolonged period of time and also that is a packaging material where there is no color fading or color change of the packaged items, and also where it is possible to prevent (suppress) the cell generation and breeding of bacteria, or mold etc.

[Measures in Order to Solve the Problems]

In order to achieve the above described goal, the packaging material according to the present invention is a packaging material that is characterized by the fact that it is formed from an electret material that has a flat surface part, which carries an electric charge with mutually different polarities on its back and front surfaces.

In the case of a packaging material that is formed from an electret material that has a flat surface part, which carries an electric charge with mutually different polarities on its back and front surfaces, such as that described above, an electric field is generated at its periphery, and because of the effect of the electric suppression that is generated from that electric field on the packaged item, by that, it becomes possible to maintain the original freshness of the packaged items and to suppress the breeding of cells, mold etc.

Regarding the electret material that forms the structure of the packaging material according to the present invention, it is correspondingly necessary that it has a flat surface part and also that the electrical charge on the front and back surface of this flat surface part have electrical charges with mutually different polarities.

As the state in order that the electret material would have a flat surface part, it is a good option if it is a sheet shaped material that has flexibility properties like films, nonwoven fabric materials, paper, woven fabric materials, etc., or it is also a good option if it is a box shape, a wooden bowl shape, a plate shape, a bottle shape etc., shaped molded structure body that has rigid properties. Namely, the flat surface part can be any of the flat surface shape, bent surface shape, solid body surface shape, and these are all good options. Especially, the sheet shaped film is the most appropriate material, and usually, it is processed into packing bags and in those bags the packaged items are placed and by that it becomes possible to tightly package them.

As the material forming the structure of the electret material used according to the present invention, because of the fact that it is necessary that it be a material where it is possible to be electrically charged so that on the back and the front surface of its flat surface part there would be electric charges with positive and negative - mutually different polarities, materials that have at least 10^{13} Ω .cm or higher, are preferred. As such materials, resin materials are preferred, and for example, polyolefin type resins, polyester type resins, fluorine containing type resins, polyvinyl chloride type resins, polyamide type resins, polyacryl type resins, etc., are preferably used. Especially, polypropylene, polyethylene etc., polyolefin type resins are preferred, and among them, polypropylene is the most preferred material.

In order to improve the surface electric charge density it is also a good option if effective additive agents are added into the above described resin material. As these preferred additive agents, for example, hindered phenols, hindered amines, sulfur type etc., anti-oxidation agents, polar macromolecular aliphatic acid metal salts, etc., can be listed and used. Also, in the resin material, it is also a good option if inorganic powder material, like a high efficiency valley possessing pebbles or porous ceramics etc., are kneaded and incorporated, so that they absorb the ethylene gas and maintain the freshness level. According to the present invention, there are no particular limitations regarding the method for the electretization of the resin material that forms the flat surface part, namely the electro charging method for charging the front and the back surface of the flat surface part with electrical charge with mutually different polarities, and it is possible to use any of the well know methods whereby in the space between an electrode where a charge is being applied and a grounded electrode, the above described flat surface part made from the resin material is made present and a high pressure is applied. For example, the electretization method reported according to the Japanese Patent Application Laid Open Number Showa 61-282471 or the Japanese Patent Application Laid Open Number Showa 61-289177, can be used as an especially preferred method.

According to the present invention, as the amount of the electric charge that is charged on the flat surface part, it is preferred that it is such that the surface electric charge density per surface is at least 1×10^{-11} Coulomb/cm2 or higher. And then, more preferably, it is at least 1×10^{-10} Coulomb/cm2 or higher, and especially preferably, it is at least 1×10^{-9} Coulomb/cm2 or higher. By imparting such surface electric charge density, an electric field is generated in the periphery of the electret material and it becomes possible to have an effect on maintaining the freshness of the packaged item.

Here, the above-described surface electric charge density is obtained according to the described here below by using the measurement device shown according to Figure 6. Namely, in Figure 6, 10 represents the grounded metal electrode manufactured from true brass, 11 represents the manufactured from the same true brass metal electrode containing a surface area of 100 cm2, and the latter metal electrode 11 is positioned so that it can move in the up and down direction relative to the plane of the described metal electrode 10. In the space between these two electrodes 10 and 11, the electret material experimental material P (surface area of 100 cm2) is inserted and at the time when the electrode 11 is moved from the closed state, which is represented by the dashed line, in

the upwards direction, the electric charge that is generated by the static electricity induced, through the condenser 12, the electric potential V measured by the electric voltage meter 13 (high performance electrometer, TR8562, manufactured by Takeda Riken).

From such measured electric potential V, the surface electric charge density of the experimental material P can be calculated according to the following here below formula.

Surface Electric Charge Density (Coulomb/cm2) = C x V/S

Where,

C: condenser capacity (Faraday)
V: electric potential (Volt)
S: surface area of the experimental material (cm2)

Especially, in the case of an electret material that is electrically charged through an electric charge by an electretization process where a resin with an increased surface electric charge density through the addition of the above described additive agent, is used, the electric charge of the inner part is highly oriented to both surfaces and polarized and the front surface and the back surface become charged with different polarities. Namely, if the front surface is charged with a positive electric charge, the back surface becomes charged with a negative electric charge. By such polarization of the inner part electric charge on both – front and back surfaces, an electric field is generated in the periphery of the electret material, and also, this electret performance becomes such that it is stable over prolonged periods of time. In this case, regarding the electric charge polarization state that exists in the electret material according to the present invention, it is not necessary that over the entire one surface side the same polarity distribution exists and it is also a good option if partially a surface part with the reversed polarity is present.

Regarding the present invention, such electret material is made into a sheet type shape or a molded structure material and it is made to be the packaging material, however, as it has been described here above, even among these items above, the film material is the most preferable packaging material according to the present invention because of the fact that due to its flexibility properties it is easy to conform and get close to the packaged items, and also it is easy to handle, and then it also has good tight sealing properties.

In the case when this resin film material is used and vegetables or fruits etc., extensive breathing raw items are packaged, it is preferred that a completely tightly sealed package is made. If the resin film is opened, through the vapor diffusion effect that accompanies the breathing, there is a generation of withering, fading and shrinkage, drying etc., and the level of freshness is decreased. However, on the other hand, if it is completely tightly sealed and packaged, through the self breathing generated gases, the concentration of the carbon oxide in the inner part of the package becomes extremely high a nd this is accompanied by the problem that it is said that the oxygen concentration is decreased. Namely, the inner part of the raw (unprocessed) item cannot breath correctly any longer,

and also, there is the problem that it has been said that the breeding of the microorganisms is promoted through the condensation of the diffused water vapors.

Because of that, in the case of the resin film that is used as a packaging material for vegetables and fruits etc., raw items, it is desirable that it is a material that has appropriate magnitude of selective permeability properties relative to carbon oxide gas and oxygen gas. These gas permeability properties vary depending on the type of the packaged items, however, relative to vegetables and fruits, etc., unprocessed items, the permeability for the carbon oxide gas is in the range of 500 ~ 350,000 cc/m2.24 hr.atm, and especially preferably, it is within the range of 25,000 ~ 250,000 cc/m2.24 hr.atm. Also, regarding the permeability relative to oxygen, it is within the range of 100 ~ 35,000 cc/m2.24 hr.atm, and especially preferably, it is within the range of 3,000 ~ 30,000 cc/m2.24 hr.atm.

Also, in the case of the resin film packaging material, its inner surface side, in order to prevent the dew formation and condensation of the water vapors that have been generated from the raw items, must have appropriate moisture permeability properties. These moisture permeability properties also vary depending on the type of the packaged items, and in the case when these are vegetables or fruits etc., raw items, the moisture permeability is within the range of 5 ~ 700 g/m2.24 hr.atm, and especially preferably, it is within the range of 20 ~ 500 g/m2.24 hr.atm. In the case when the moisture permeability is less than 5 g/m2.24 hr.atm, it becomes a cause for color fading or color change, and also, in the case when it becomes higher than 700 g/m2.24 hr.atm, there is a generation of withering, shrinkage, drying, etc., and there is the danger that the level of freshness would be significantly decreased.

Moreover, in the case when even among the green fruits, items that have especially high moisture diffusion, are packaged, it is also a good option if as their packaging material, a material is used where numerous openings are appropriately opened, so that the water that is evaporated from the green vegetables and fruits can be prevented from condensing.

In the case when the packaged items are beef meat, etc., meet type products, it is preferred that the oxygen permeability is made to be even lower than that in the above described case for the raw items. Namely, regarding the oxygen permeability properties that must be possessed by a resin film that is used in such type of application, it is preferred that they are within the range of 5 ~ 200 g/m2.24 hr.atm, and especially preferably, within the range of 20 ~ 100 g/m2.24 hr.atm. In the case when the oxygen permeability properties are lower than 5 g/m2.24 hr.atm, this becomes a cause for color fading and color change, and also, in the case when it exceeds 500 g/m2.24 hr.atm, there is the danger that there would be oxidation and an acceleration of the breeding of microorganisms.

Moreover, according to the present invention, the above described carbon oxide gas permeability, oxygen permeability, moisture permeability, are correspondingly measured according to the regulations presented in the following JIS.

Carbon oxide gas permeability: JIS Z 1707 method
(20oC, 90 % RH)

Oxygen permeability: JIS Z 1707 method
(20oC, 90 % RH)

Moisture permeability: JIS Z 0208 method
(40oC, 90 % RH)

Also, because of the fact that if ultraviolet light is absorbed inside the beef meat, etc., meat type products, the color change and the oxidation are accelerated, it is also a good option if for the resin film used for the application of packaging such items, the resin film itself is colored or printed in a red – orange color etc., so that it would cut off the ultraviolet light, or if it is covered and combined with another red-orange color colored sheet.

In the case when resin film is a packaging material, in order to make the adhesion properties with the packaged item good, its thickness is within the range of 4 microns ! 300 microns, and then more preferably, it is within the range of 6 microns ~ 100 microns, and especially preferably, within the range of 10 microns ~ 50 microns. If the thickness is less than 4 microns, there is the danger that it is easy to generate breaks through force from the outer part, and also in the case when the thickness exceeds 300 microns, the flexibility properties are decreased and there is the danger that the packaging performance properties would also be decreased.

Figure 1 is a diagram that shows an example of a packaging material M according to the present invention that is formed from the sheet shaped resin film 1.Regarding the resin film 1, because it has been electretized, the inner part electric charge is polarized on the two surfaces – the front and the back surface, and the front surface becomes charged with a positive electric charge, and the back surface becomes charged with a negative electric charge. For the packaging of the item subjected to the packaging by using this resin film 1 packaging material M, it is a good option if the item to be packaged is packaged directly in the state as it is, however, it is also a good option if the packaging material itself is processed in advance to become a bag and then the item is placed in this bag.

Also, it is a good option if the packaging is done by using one single ply of the above described resin film, however, as it is shown according to the presented in Figure 2, it is also a good option if a laminated layer is used that is produced by the layer lamination of a number of layers. In the case of such laminated layer structure, the directions of the orientation distribution of the polarity of the electric charge are made to be the same direction, and it is necessary that in the space between the immediately adjacent resin films, a surface that is charged with a positive electric charge and a surface that is charged with a negative electric charge, are made to be mutually facing each other. Through such laminated layer material, the polar properties of the surface of the outermost side of the laminated layer material are strengthened even more, and it is possible to make the electric field stronger, and because of that it becomes possible to

prolong even further the maintained working life of the packaged items. Also, relative to the other conditions, also, the durability properties, the chemical resistance properties, the thermal resistance properties, the cold resistance properties, become improved.

Also, for such layer lamination of a number of resin films, so that their electret performance is not lost, it is also a good option if the space between the films is adhered by using an adhesive agent, or if a mechanical adhesion is conducted. Or it is also a good option if by using an embossing technological process or an ultrasound wave adhesion, it is made into a one body material. However, it is necessary to limit the number of the layers so that for this laminated layer material the properties that are inherent to the film itself, like the carbon oxide gas permeability, the oxygen permeability, the moisture permeability, etc., would not be lost.

Also, in the case when a resin film is the packaging material, as it is shown according to the presented in Figure 3, it is also a good option if the resin film 1 of the electret material is combined with a nonwoven fabric material, a woven fabric material, a paper material, etc., other sheet shaped material 2. Regarding the sheet shaped material 2 that is used in the combined type application, it is a good option if it is electretized and it is also a good option if it is not electretized. However, regarding this sheet shaped material used in the combined type application, its thickness etc., ranges must be carefully and appropriately selected within the range where there is no adverse effect on the electric effect of the resin film 1 of the electretized material.

The packaging material M according to Figure 4 is a material that is formed from the resin molded structure body 3. This packaging material M does not have flexibility properties like those of the film material, and it becomes a material that has an appropriate level of rigidity. Naturally, in the case of the molded structure body 3, it is formed from an electretized material, and its front surface and its back surface are correspondingly electrically charged with a positive and a negative electric charge. On the front surface of the molded structure body 3, numerous wooden bowl shaped recessed parts 4, are formed, and in these recessed parts 4 correspondingly, the packaged material A like apples, or Kumo province tangerines, etc., citrus fruits, become housed. Here, only one part of the electret material becomes covered so that the entire circumference range of the packaged items would not be encompassed.

In the case of such molded structure body 3 where in the numerous recessed parts 4 correspondingly apples or Kumo province tangerines etc., are housed, for example, as it is shown according to the presented in Figure 5, it is placed and housed in a multi step type of arrangement in the corrugated fiberboard box 5. Then, optionally (depending on the requirements), it is also a good option if the total body periphery of the above described arranged in multiple steps number of molded structure bodies 3, or if each step separately, are wrapped by using the electretized material resin film 1.

In the case of such rigid properties possessing molded structure body, it is not limited to the above described wooden bowl type shape, and in correspondence to the packaged

materials, for example, it is also possible to be made into any type of shape like a box shape, a plate shape, a bottle shape etc.

In the case of described here above packaging of items subjected to packaging by using the packaging material according to the present invention, depending on this item that is to be packaged, it is not necessary that its whole body be packaged and it is also a good option if only one part of the item is packaged. By the coverage of the item to be packaged by the packaging material, an electric inhibition is generated through the electric field generated by the electretized material, and the decrease of the level of freshness of the packaged item is suppressed or the generation of mold etc., is microorganisms is suppressed. At the time of the coverage of the item subjected to the packaging by such packaging material, it is a good option if the polarity of the electric charge of the pair of surfaces of this packaging material are each positive and negative, correspondingly, however, according to the practical testing results obtained by the authors of the present invention, it was understood that the negative electric charge generates and demonstrates higher effects of maintaining the level of freshness and preservation.

Also, regarding these freshness level maintenance or preservation effects, the larger the electric field that is generated by the electretized material, the larger these effects become, and especially, this is an important trend relative to the packaging of plants.

Also, if the air that is present in the space between the material subject to the packaging and the packaging material comprised of the electretized material is removed, it is possible to suppress the bacteria, or mold etc., microorganism breeding and it is possible to even further improve the preservation effect. This result is also increased as the level of the vacuum is increased.

Regarding the above described packaging material according to the present invention, its application is not limited to vegetables, fruits, etc., raw food products, and it can be used in the general wide application packaging field where it is required that the original state is not changed and it is maintained for prolonged period of time, like the preservation and packaging of live flowers for viewing, etc., live items packaging, food product preservation and packaging, preservation and packaging of harvested animal body parts etc.

Practical Example 1

By using an electretized material comprised of polypropylene film with a 10 micron film thickness, where the front and back surface surface electric charge density is positive 3 x 10^{-9} Coulomb/cm2, and negative 2.7 x 10^{-9} Coulomb/cm2, correspondingly, the carbon oxide gas permeability is 45,000 cc/m2.24 hr.atm, the oxygen permeability is 12,500 cc/m2.24 hr.atm, the moisture permeability is 35 g/m2.24 hr.atm (added materials: hindered phenol 800 ppm) potatoes were packaged.

Regarding the packaging method, two methods were used, one where relative to the surface of the potato, the positive polarity surface of the packaging material was mutually facing, and the other, where the negative polarity surface of the packaging material was facing the surface of the potato, and then the results of the preservation of the freshness level of these packaged items, was evaluated by testing. The number of test specimens in each was made to be 5.

Also, as a comparison, a not electretized polypropylene film where everything else was the same (the surface electric charge density was below the measurement limits and could not be measured), was used, and the same way, 2 potatoes were packaged, and the results of the preservation of the freshness level of these packaged items, was evaluated by testing.

These test samples were placed in a room temperature 25 ~ 35oC, and humidity 65 ~ 85 % ambient air environment, and they were visually observed. As a result from that, after the passing of one month in the case of the reference test sample (the sample that has been packaged with non electretized polypropylene film), there was a generation of white mold.

Relative to that, in the case of the test sample packaged by the electretized material, both in the case where the item was packaged by the positive polarity surface side and the case where the item was packaged by the negative polarity surface side, in both cases, even after the passage of 2 months, there was no mold generation, and also, there was no withering, and the freshness level preservation effect was visually confirmed.

Practical Example 2

The same electretized material as that used according to the Practical Example 1, was used and only the blossom part was covered by the negative polarity surface and packaged and the stem part was immersed in water in order to get water.

Also, as a comparison, by using polypropylene film that has not been electretized but other than that has the same properties as described above (the surface electric charge density was below the measurement limits and could not be measured), was used, and the same packaging was conducted.

At the time when the state of these two experimental samples was evaluated after the passage of 1 week was visually observed, for the blossom part of the experimental sample that has been packaged by using the electretized polypropylene material there was no color tone change or withering and shrinkage, and the freshness level was well preserved. However, the blossom part in the case of the referenee comparison sample (the item that was packaged by using a non-electretized polypropylene film) showed a yellowing color tone, and also it showed a withered state.

Practical Example 3

Two plies of electret material comprised of polypropylene film with a 12 micron film thickness, where the front and back surface surface electric charge density is positive 9 x 10^{-9} Coulomb/cm2, and negative 1 x 10^{-8} Coulomb/cm2, correspondingly, the carbon oxide gas permeability is 30,000 ~ 40,000 cc/m2.24 hr.atm, the oxygen permeability is 7,200 ~ 11,800 cc/m2.24 hr.atm, the moisture permeability is 27 ~ 29 g/m2.24 hr.atm, are layer laminated so that their electric field directions become the same.

This laminated layer polypropylene film is made to be the packaging material and its negative polarity surface is tightly adhered to the front surface of a Kumo province tangerine and it is completely and tightly packaged, and it was placed in a room at a room temperature of 20oC +/-2oC, and a relative humidity of 65 % +/-2%.

The number of the samples was made to be 20, and by observing the changes of the decay (rotting) state with the passing of the days, the preservation ratio K, was obtained. The preservation ratio K was obtained according to the shown here below formula.

$$\text{Preservation ratio K (\%)} = \frac{N - n}{N} \times 100$$

Where,

N: number of the tested experimental samples
N: number of samples where there have been defects generated due to rotting, mold, drying etc.

The results according to the above described formula showed that after 1 month the preservation ratio was 100 %, after 2 months the preservation ratio was 70 %. Also, the appearance for these large number of samples was not deteriorated and the preservation results were extremely good.

Reference Example 1

Two plies of polypropylene film that had the same thickness and the same carbon oxide gas permeability, oxygen permeability and moisture permeability as the film according to the Practical Example 3, but had not been electretized, were layer laminated.

This layer laminated polypropylene film was used as a packaging material and the same way as in the case of the Practical Example 3 Kumo province tangerines were packaged. The sample number, the storage conditions, were all the same as those according to the above Practical Example 3 and the same type testing was conducted.

As a result from that the preservation ratio after one month was 60 % and the preservation ratio after 2 months was 5 %, and compared to the preservation ratio obtained according to the Practical Example 3, it was extremely poor.

Reference Example 2

Two plies of 10 micron thick, commercially available, vinylidene chloride type film where the carbon oxide gas permeability was 72 ~ 105 cc/m2.24 hr.atm, the oxygen permeability was 32 ~ 40 cc/m2.24 hr.atm and the moisture permeability was 2 ~ 2.5 g/m2.24 hr.atm, were layer laminated and this was made to be the packaging material and the same way as described according to the Practical Example 3 Kumo province tangerines were completely and tightly packaged. The sample number, the storage conditions, were all the same as those according to the above Practical Example 3 and the same type testing was conducted.

As a result from that the preservation ratio after one month was 30 % and the preservation ratio after 2 months became 0%, and all samples were rotten and they did not preserve the original shape.

Reference Example 3

Two plies of polyethylene film that had the same thickness as the film according to the Practical Example 3, but had not been electretized, and where the carbon oxide gas permeability was 28,000 ~ 36,000 cc/m2.24 hr.atm, the oxygen permeability was 9,000 ~ 10,000 cc/m2.24 hr.atm and the moisture permeability was 29 ~ 31 g/m2.24 hr.atm, were layer laminated and this was made to be the packaging material. This layer laminated polypropylene film was used as a packaging material and the same way as in the case of the Practical Example 3 Kumo province tangerines were packaged. The sample number, the storage conditions, were all the same as those according to the above Practical Example 3 and the same type testing was conducted.

As a result from that the preservation ratio after one month was 10 % and the preservation ratio after 2 months was 0 %, and all the samples were rotten and mold had been generated.

Reference Example 4

The same Kumo province tangerines were used in the state as they are harvested without using a resin film and also the sample number, the storage conditions, were all the same as those according to the above Practical Example 3 and the same type testing was conducted.

As a result from that the preservation ratio after one month was 10 % and the preservation ratio after 2 months was 0 %, and all the samples were rotten and shrunk and there was no preservation of freshness at all.

Practical Example 4

24 micron thick, electretized polypropylene film, where the front and back surface surface electric charge density is positive 9 x 10^{-9} Coulomb/cm2, and negative 9 x 10^{-9} Coulomb/cm2, correspondingly, the carbon oxide gas permeability is 13,000 ~ 20,000 cc/m2.24 hr.atm, the oxygen permeability is 3,400 ~ 6,000 cc/m2.24 hr.atm, the moisture permeability is 14 ~ 16 g/m2.24 hr.atm was used as the packaging material and a clover was enclosed in the space between two plies of this material that were combined so that the positively charged surfaces were mutually facing each other, and by using a heat cutter, the area that is at a distance of 5 cm from this clover was melted and cut and a large number of tightly packaged samples, where air was not entering or dissipating, was produced.

These samples were stored in a room at a room temperature of 20oC +/-2oC and moisture of 65 % +/-2%, and the color fading or color change of the clover, was monitored.

As a result from that it was seen that after 2 months the leaves of the clover were somewhat shrunk, and the color of the leaves showed no color fading or color change and was a deep green color. Also, there was no generation of mold at all.

Reference Example 5

Polypropylene film that had not been electretized and that had the same thickness, carbon oxide permeability, oxygen permeability, and moisture permeability as the film used according to the Practical Example 4, was used as the packaging material and in the space between two plies of this film, the same clover was enclosed and by using a heat cutter, the area that is at a distance of 5 cm from this clover was melted and cut and a large number of tightly packaged samples, where air was not entering or dissipating, was produced. The sample number and the storage conditions were exactly the same as described according to the Practical Example 4 above, and the same testing was conducted.

As a result from that it was observed that after the passage of 3 weeks almost all the samples had a progress of color fading of the leaves, and at the time when 1 month had passed all had changed the color to a brown color. And also, it was confirmed that after 1 month, 40 % of the samples had generated mold.

Reference Example 6

10 micron thick, commercially available, vinylidene chloride type film where the carbon oxide gas permeability was 72 ~ 105 cc/m2.24 hr.atm, the oxygen permeability was 32 ~ 40 cc/m2.24 hr.atm and the moisture permeability was 2 ~ 2.5 g/m2.24 hr.atm, was made to be the packaging material, and between two plies of this film, the same clover as in the case of the Practical Example 4, was enclosed, and by using a heat cutter, the area that is at a distance of 5 cm from this clover was melted and cut and a large number of tightly packaged samples, where air was not entering or dissipating, was produced.

As a result from that it was observed that after the passage of 2 weeks almost all the samples had a progress of color fading of the leaves, and at the time when 3 weeks had passed all had changed the color to a brown color. And also, after 1 month 100 % of the samples had generated mold.

Reference Example 7

Polyethylene film that had the same thickness as the film according to the Practical Example 4, but had not been electretized, and where the carbon oxide gas permeability was 12,000 ~ 19,000 cc/m2.24 hr.atm, the oxygen permeability was 4,000 ~ 5,000 cc/m2.24 hr.atm and the moisture permeability was 15 ~ 17 g/m2.24 hr.atm, was made to be the packaging material, and between two plies of this film, the same clover as in the case of the Practical Example 4, was enclosed, and by using a heat cutter, the area that is at a distance of 5 cm from this clover was melted and cut and a large number of tightly packaged samples, where air was not entering or dissipating, was produced.

As a result from that it was observed that after the passage of 2 weeks almost all the samples had a progress of color fading of the leaves, and at the time when 3 weeks had passed 50 % had changed the color to a yellow color and 35 % had changed to a yellow-brown color. And also 15 % had changed to a brown color, and the percent of the samples remaining with green color was only 5 %. And also, it was confirmed that after 1 month 25 % of the samples had generated mold.

Besides that, experiments were conducted with vegetables like spinach, etc., fruits like apples, flower blossoms or sold in the flower shops margaritas, or small flower blossoms, stems, leaves etc., and the same reference experiments as those described here above were conducted.

The results showed that there were differences in the number of days until they rotted depending on the type of the packaged material, however in any of these cases, the method using the packaging material according to the present invention showed excellent results.

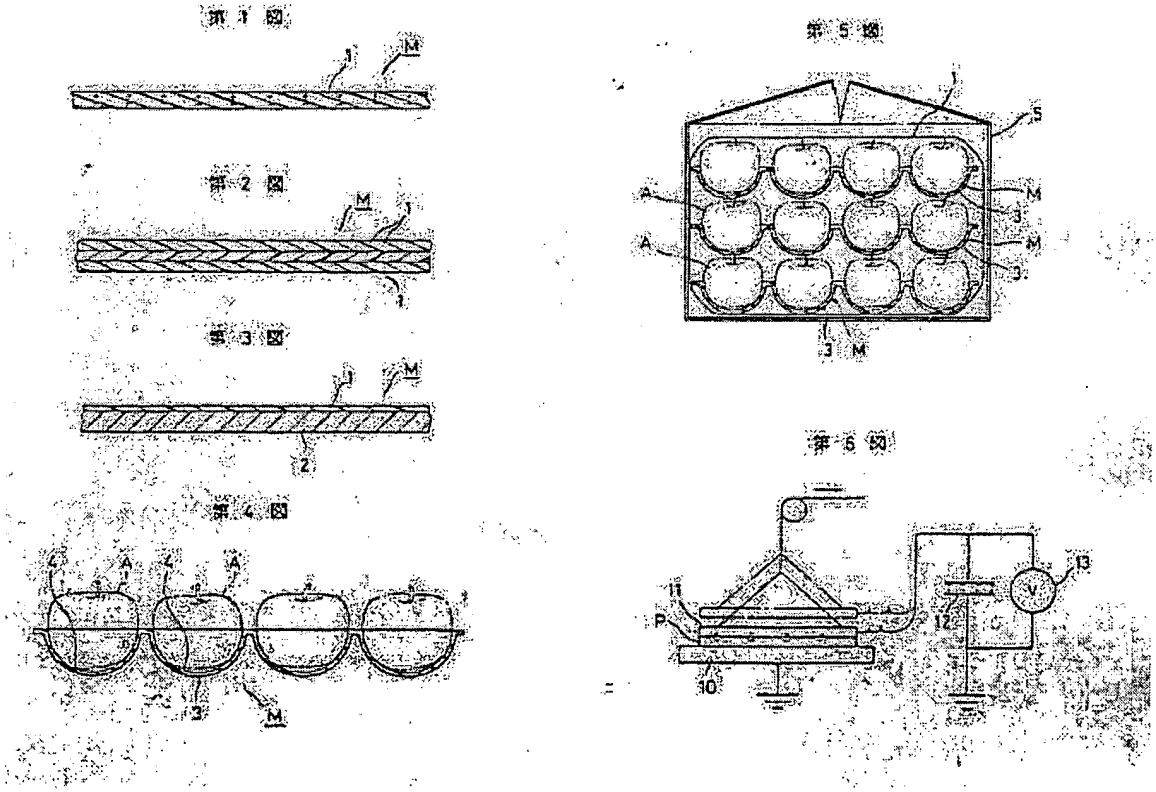
(Results From the Present Invention)

As it has been described here above, in the case of the packaging material according to the present invention, the electretized material through the generated electric field has an electric hindrance effect and it results in a suppression of the decrease of the freshness level and also of the breeding and growth of microorganism cells, and it is possible to preserve the packaged materials for a prolonged period of time in their original state. Also, it is possible to achieve preservation for a prolonged period of time where a good appearance is preserved and there is little color tone fading or color change of the packaged material.

4. Brief Explanation of the Figures

Figure 1 is a longitudinal cross sectional view diagram of one part of the packaging material according to the present invention that if comprised of a resin film. Figure 2 is a longitudinal cross sectional view diagram of one part of the packaging material according to the present invention that if comprised of a laminated layer body resin film in the case of another practical example. Figure 3 is a longitudinal cross sectional view diagram of one part of the packaging material according to the present invention that if comprised of a composite body formed from a resin film and another sheet shaped material, in the case of yet another practical example. Figure 4 is a longitudinal cross sectional view diagram of one part of the packaging material according to the present invention that if comprised of a resin molded structure body, in the case of yet another practical example. Figure 5 is an explanation diagram showing an example of the packaging method using the packaging material according to the present invention. Figure 6 is a schematic diagram of the measurement device used for the measurement of the surface electric charge density of the electretized material.

M.....packaging material, 1.....resin film,
3.....molded structure body.



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⑤4発明の名称　包装材

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⑦2発明者　安藤　勝敏　滋賀県大津市園山1丁目1番1号　東レ株式会社滋賀事業場内
⑦2発明者　小川　勝也　滋賀県大津市園山1丁目1番1号　東レ株式会社滋賀事業場内
⑦2発明者　井伊　由一　滋賀県大津市園山1丁目1番1号　東レ株式会社滋賀事業場内
⑦2発明者　奥村　由治　滋賀県大津市園山1丁目1番1号　東レ株式会社滋賀事業場内
⑦1出願人　東レ株式会社　東京都中央区日本橋室町2丁目2番1号
⑦4代理人　弁理士　小川　信一　外2名

明細書

1．発明の名称

包装材

2．特許請求の範囲

(1) 表裏両面に互いに極性の異なる分極された電荷をもつ面状部を有するエレクトレット材料からなる包装材。

(2) 面状部に帯電する片面当たりの表面電荷密度が1×10^{-11}クーロン／cm以上である請求項1記載の包装材。

(3) エレクトレット材料が樹脂を素材とするフィルム，不織布，紙，編織物から選ばれたシート状物よりなる請求項1または2記載の包装材。

(4) エレックレット材料が樹脂からなる成形構造体よりなる請求項1または2記載の包装材。

(5) 樹脂がポリオレフィン系樹脂，ポリエステル系樹脂，含フッ素系樹脂，ポリ塩化ビニル系樹脂，ポリアミド系樹脂，ポリアクリル系樹脂から選ばれたものである請求項3または4記載の包装材。

(6) エレクトレット材料が樹脂フィルムからなり、該樹脂フィルムの炭酸ガス透過度が500～350,000 cc/㎡・24hr・atm、酸素透過度が100～35,000 cc/㎡・24hr・atmであって、生鮮物包装用に使用される請求項3記載の包装材。

(7) エレクトレット材料が樹脂フィルムからなり、該樹脂フィルムの透湿度が5～700g/㎡・24hrであって、生鮮物包装用に使用される請求項3または6記載の包装材。

(8) エレクトレット材料が樹脂フィルムからなり、該樹脂フィルムの酸素透過度が5～200 cc/㎡・24hr・atmであり、食肉類の包装用に使用される請求項3記載の包装材。

(9) エレクトレット材料が樹脂フィルムからなり、該樹脂フィルムに多数の孔が開けられている生鮮物包装用に使用される請求項3記載の包装材。

3．発明の詳細な説明

〔発明の技術分野〕

本発明は包装材に関し、さらに詳しくは被包

装物の元の鮮度を長期間保持するように包装する包装材に関する。

（従来技術）

従来、スーパーマーケットや食料品店などでは野菜や果物などの生鮮物の鮮度を保持するため、ポリ塩化ビニリデン系樹脂やポリエチレン樹脂などの樹脂フィルムで包装する方法が行われている。この樹脂フィルムでの包装は、水分の蒸発を抑制すると共に、外部からの汚れに対して商品価値が低下するのを防止するため、ある程度の効果は有していた。

しかし、この樹脂フィルムによる包装方法は、単に水分の蒸発を抑制したり、汚れを防止したりするだけであり、被包装物に繁殖する細菌やカビなどの生殖細胞を抑制する効果は有していないため、約一週間以上放置すると、被包装物にカビなどが発生するのを防止することはできなかった。また、野菜や果物などの生鮮物は退色したり、変色したりするが、この包装方法ではこの色の退色や変色を有効に防止することはできなかった。

したがって、従来の樹脂フィルムによる包装方法では、さらに長期間にわたって鮮度を保持したり、カビの発生を防止したりしようとするときには限界があった。

〔発明が解決しようとする課題〕

本発明の目的は上述した従来技術の限界を打破し、さらに長期間にわたって元の鮮度を保持できるようにする包装材を提供することにある。さらに具体的には、野菜，果物などの生鮮物に限らず、動植物の採取標本などの多くの種類の被包装物を、その元の鮮度を長期間にわたり保持させ、かつ退色や変色させることなく、また細菌やカビなどの生殖細胞の繁殖を抑制できるようにする包装材を提供することにある。

〔課題を解決するための手段〕

上記目的を達成するための本発明の包装材は、表裏両面に互いに極性の異なる分極された電荷をもつ面状部を有するエレクトレット材料からなることを特徴とするものである。

上記のように面状部の表裏両面に極性の異なる分極された電荷を有する包装材は、その周囲に電界を発生し、その電界による電気的刺激が被包装物に作用するため、それによって被包装物の鮮度の保持や細菌，カビ等の繁殖の抑制を行うことができるようになる。

本発明において包装材を構成するエレクトレット材料は面状部を有し、かつその面状部の表裏両面に互いに分極された極性の異なる電荷をそれぞれ有することが必要である。

エレクトレット材料が面状部を有するための形態としては、フィルム，不織布，紙，編織物などの可撓性をもつシート状物であってもよく、或いは箱状，椀状，皿状，ボトル状などの形状をした剛性をもった成形構造体であってもよい。すなわち、面状部は平面状，曲面状，立体面状のいずれであってもよい。特にシート状物のフィルムは最適であり、一般には袋状に加工され、その中に被包装物を挿入することによって密封包装が可能になる。

本発明に使用するエレクトレット材料の構成素材としては、その面状部の表裏両面に正負に分極された電荷を帯電できるものでなければならないので、少なくとも電気比抵抗が$10^{13}\Omega$・cm以上であるものが好ましい。このような素材としては樹脂が好ましく、例えばポリオレフィン系樹脂、ポリエステル系樹脂、含フッ素系樹脂、ポリ塩化ビニル系樹脂、ポリアミド系樹脂、ポリアクリル系樹脂などが好ましく適用される。特にポリプロピレン，ポリエチレンなどのポリオレフィン系樹脂は好ましく、なかでもポリプロピレンは最適の素材である。

上記樹脂の中には、表面電荷密度を向上させるために有効な添加剤を添加するとよい。その好ましい添加剤としては、例えばヒンダードフェノール，ヒンダードアミン，硫黄系などの抗酸化剤，有極性高分子脂肪酸金属塩などを挙げることができる。また、樹脂中にエチレンガスを吸収して鮮度を保持するのに有効な大谷石や多孔質セラミック等の無機質粉末を添加剤とし

て練り込むようにしてもよい。

本発明において、面状部を形成した樹脂素材をエレクトレット化する方法、すなわち面状部の表裏に分極された電荷を帯電させる方法としては特に限定されず、印加電極とアース電極の間に上記樹脂素材の面状部を介在させて高圧印加する公知の方法がいずれも使用可能である。例えば、本発明者がすでに提案している特開昭６１－２８２４７１号公報や特開昭６１－２８９１７７号公報に記載されたエレクトレット加工法は、特に好ましい方法として使用できる。

本発明において、面状部に帯電させる電荷量としては、片面当たりの表面電荷密度が1×10^{-11}クーロン／cm²以上であるようにするのが好ましい。さらに好ましくは1×10^{-10}クーロン／cm²以上、特に好ましくは1×10^{-9}クーロン／cm²以上であることである。このような表面電荷密度を与えることによって、エレクトレット材料の周辺に電界が発生し、被包装物の鮮度保持に有効に作用することになる。

ここで、上記表面電荷密度は、第６図に示すような測定機構によって次のようにして求められる。すなわち、第６図において、１０は真鍮製のアースされた金属電極、１１は同じく真鍮製の面積１００cm²を有する金属電極であり、後者の金属電極１１は上記金属電極１０に対面して上下動するようにしてある。これら両電極１０，１１の間にエレクトレット材料の試料Ｐ（面積１００cm²）を挟み込み、電極１１を閉じた状態から鎖線で示すように上動させたときの静電誘導によって生じた電荷を、コンデンサー１２を介して電圧計１３（高性能エレクトロメーター，武田理研製　ＴＲ８５６２）で電位Ｖを測定する。

このように測定した電位Ｖから、試料Ｐの表面電荷密度を、次の計算式から求めるのである。

表面電荷密度（クーロン／cm²）＝Ｃ×Ｖ／Ｓ

但し、Ｃ：コンデンサー容量（ファラッド）

Ｖ：電位（ボルト）

Ｓ：試料面積（cm²）

特に前述した添加剤を添加して表面電荷密度を向上させるようにした樹脂を使用し、エレクトレット加工によって電荷を帯電させたエレクトレット材料では、内部電荷が両面に高配向して分極し、表面と裏面とでは異極性を有するようになる。すなわち、表面に正電荷を帯びていれば、裏面には負電荷を帯びた状態になっている。このように内部電荷が表裏両面に分極することによって、エレクトレット材料の周辺には電界が形成され、かつそのエレクトレット性能を長期にわたって安定化させるようになる。この場合、本発明におけるエレクトレット材料における電荷の分極状態は、必ずしも同一面側に全て同じ極性を分布させる必要はなく、部分的に極性を逆転させた面部分を散在させていてもよい。

本発明は、このようなエレクトレット材料を、シート状物或いは成形構造物にして包装材にするが、前述したように、これらのうちでも樹脂フィルムは柔軟で被包装物に馴染みやすく、かつ扱いやすく、さらに密封性も有するため、本発明の包装材として最適である。

この樹脂フィルムを使用して、野菜や果物などの呼吸の盛んな生鮮物を包装する場合は、完全密封包装にすることが好ましい。樹脂フィルムを開放しておくと、呼吸に伴う蒸散作用により、萎凋，萎縮，乾燥などが生じて鮮度を低下するからである。しかし、その他方で、完全密封包装すると、自己の呼吸したガスによって、包装内部の炭酸ガス濃度が異常に高くなり、酸素濃度が低下するという現象が伴う。すなわち、内部の生鮮物は正常な呼吸が不可能となり、また蒸散した水蒸気が結露することによって微生物の繁殖を促進するという問題を有するのである。

このため、野菜や果物などの生鮮物の包装材として使用する樹脂フィルムは、炭酸ガス及び酸素に対して適度な大きさの選択的透過性を有していることが望ましい。このガス透過性は被包装物の種類によっても異なるが、野菜や果物

などの生鮮物用に対しては、炭酸ガス透過度が５００～３５０，０００cc／㎡・24hr・atm、更に好ましくは２５，０００～２５０，０００cc／㎡・24hr・atm の範囲であることが好ましい。また、酸素透過度は１００～３５，０００cc／㎡・24hr・atm、更に好ましくは３，０００～３０，０００cc／㎡・24hr・atm の範囲であることが好ましい。

また、樹脂フィルムの包装材において、その内面に、生鮮物から蒸散した水蒸気が凝縮して結露するのを防止するためには、適当な透湿性を有することが必要である。この透湿性も被包装物の種類によって異なり、野菜や果物などの生鮮物の場合には、透湿度は５～７００g／㎡・24hr、更に好ましくは２０～５００g／㎡・24hrであることが好ましい。透湿度が５g／㎡・24hrよりも小さい場合は退色や変色の原因になり、また７００g／㎡.24hr より大きいと、萎凋，萎縮，乾燥などが生じて鮮度を著しく低下するようになる恐れがある。

なお、青果物のなかでも特に水蒸気の蒸散が多いものを包装する場合には、その包装材に多数の孔を適宜開けたものを使用し、青果物が蒸散する水分による結露を防止できるようにするとよい。

被包装物が獣肉などの食肉類の場合は、酸素の透過性を上記生鮮物の場合よりも低いものにすることが好ましい。すなわち、この用途に使用する樹脂フィルムが有すべき酸素透過性は、５～２００cc／㎡・24hr・atm、更に好ましくは２０～１００cc／㎡・24hr・atm の範囲が好ましい。酸素透過度が５cc／㎡・24hr・atm よりも小さい場合は退色や変色の原因となり、また２００cc／㎡・24hr・atm を越えると酸化して微生物の繁殖を促進する恐れがある。

なお、本発明において、上述した炭酸ガス透過度、酸素透過度、透湿度とは、それぞれＪＩＳ規格の次の規定によるものである。

炭酸ガス透過度：ＪＩＳ　Ｚ　１７０７法
（２０℃　９０％ＲＨ）

酸素透過度：ＪＩＳ　Ｚ　１７０７法
（２０℃　９０％ＲＨ）

透湿　度：ＪＩＳ　Ｚ　０２０８法
（４０℃　９０％ＲＨ）

また、獣肉などの食肉類は紫外線を受けると変色や酸化を促進するため、これを包装する用途の樹脂フィルムには、紫外線をカットするように樹脂フィルム自身に赤橙色などの着色または印刷を施したり、或いは他の赤橙色の着色シートと複合させたりするとよい。

樹脂フィルムが包装材である場合、その厚さは被包装物との密着性を良好にするため４μm～３００μm 程度、さらに好ましくは６μm～１００μm、特に好ましくは１０μm～５０μmにすることが好ましい。この厚さが４μm未満では、外部からの力により簡単に破れを生じる恐れがあり、また３００μm を越えると柔軟性が低下して包装性能を低下する恐れがある。

第１図は、シート状の樹脂フィルム１からなる本発明の包装材Ｍを例示したものである。樹脂フィルム１はエレクトレット化されているため内部電荷が表裏両面に分極され、表面に正電荷を帯電し、裏面に負電荷を帯電するものになっている。この樹脂フィルム１の包装材Ｍを使って被包装物を包装するには、そのまま被包装物を直接包むようにしてもよいが、予め袋状に加工したのちに、その袋の中に入れるようにしてもよい。

また、上記樹脂フィルムを単独の１枚で包装するようにしてもよいが、第２図に示すように複数枚を積層した積層体にして使用してもよい。このような積層構造に場合は、分極電荷の配向分極方向を同一方向にし、隣接する樹脂フィルム間で正電荷が帯電した面と負電荷が帯電した面とを互いに対面させるようにすべきである。このような積層により最外側の面の極性を一層強化させ、電界を大きくすることができるから、被包装物の保存寿命を一層長くすることができるようになる。また、外的条件に対しても耐久性、耐薬品性、耐熱性、耐寒性が向上するよう

になる。

また、このように複数の樹脂フィルムを積層するには、そのエレクトレット性能を失わないようにするため、フィルム相互間を接着剤で接着するとか、機械的な接着を行うようにするとよい。或いは、エンボス加工や超音波接着で一体化するようにしてもよい。ただし、この積層によってフィルム自身が有する炭酸ガス透過度、酸素透過度、透湿度などの特性を失わなうことがないように、枚数を限定する必要がある。

また、樹脂フィルムが包装材である場合には、第3図に示すように、エレクトレット材料の樹脂フィルム1を不織布、織編物、紙などの他のシート状物2と複合させた複合材にしてもよい。複合用に使用するシート状物2は、エレクトレット化されていてもよく、いなくてもよい。ただし、その複合に使用するシート状物は、エレクトレット材料の樹脂フィルム1の電気的作用を阻害するものであってはならず、その厚さなどの範囲を慎重に選択すべきである。

第4図の包装材Mは樹脂の成形構造体3からなるものである。この包装材Mは、フィルムのような柔軟性はなく、適度の剛性を有するものとなっている。もちろん、成形構造体3はエレクトレット材料からなり、その表面と裏面とには正負に分極された電荷をそれぞれ帯電している。成形構造体3の表面には椀状の多数の凹部4が形成され、それぞれの凹部4に林檎や蜜柑等の柑橘類などの被包装物Aが収納されるようになっている。ここで、エレクトレット材料は被包装物の全周囲を囲むようにはなっておらず、一部だけを覆うようになっている。

このように多数の凹部4のそれぞれに林檎や柑橘類などの被包装物を収納した成形構造体3は、例えば第5図のように、ダンボール箱5の中に多段に積んで収納される。さらに必要により、上記多段に積まれた複数の成形構造体3の周囲全体を、或いは各段毎にエレクトレット材料の樹脂フィルム1で包装するようにしてもよい。

このような剛性をもつ成形構造体は、上記のような椀形状に限られず、被包装物に応じて例えば箱形、皿形、ボトル形などの他の任意の形状にすることができる。

上述のように本発明の包装材によって被包装物を包装する場合には、その包装物に応じて必ずしも全体を覆うことは必要なく、一部だけであってもよい。包装材が被包装物を覆うことによって、エレクトレット材料から発生する電界による電気的刺激が作用し、被包装物の鮮度低下を抑制したり、あるいはカビなどの微生物の発生を抑制したりする。このように包装材によって被包装物を覆うとき、その包装材が対面する側の表面の電荷極性は、正負いずれであってもよいが、本発明者らの実験結果によれば負電荷の方がより高い鮮度保持または保存効果を発揮することがわかった。

また、この鮮度保持または保存効果は、エレクトレット材料が発生する電界が大きければ大きいほど大きくなり、特に植物の被包装物に対して顕著に顕れる。

また、被包装物と本発明のエレクトレット材料からなる包装材との間に存在する空気を除去すると、細菌やカビなどの生殖細胞の繁殖を抑制することができ一層保存効果を向上することができる。この効果は真空度を上げれば上げるほど向上する。

上述した本発明による包装材は、野菜．果物などの生鮮食品の保存包装に限らず、観賞用の生花などの生鮮物の保存包装、食肉類の保存包装、採取した動植物の標本類の保存包装など、元の状態を変化させることなく長期間保持したい包装一般に広く利用することができる。

実施例1

表裏の表面電荷密度が、正3×10⁻⁹クーロン／㎠、負2．7×10⁻⁹クーロン／㎠で、炭酸ガス透過度45，000cc／㎡・24hr・atm、酸化透過度12，500cc／㎡・24hr・atm、透湿度35g／㎡・24hrである厚さ10μmのポリプロピレンフィルム（添加物：ヒンダー

ドフェノール８００ppm)からなるエレクトレット材料を用いてジャガイモを包装した。

包装方法は、ジャガイモ面に対して、正極性面が対向するものと、負極性面が対向するものとの２種類を作り、これら包装による鮮度保持効果を試験評価した。試験個数は、それぞれ５個ずつとした。

また、比較のため、エレクトレット化されていない他は上記と同様のポリプロピレンフィフルム（表面電荷密度は測定限界以下で測定不能）を使用して、同様にジャガイモを５個包装して鮮度維持効果を試験評価した。

これら試験サンプルを、室温２５～３５℃、湿度６５～８５％の雰囲気中に放置して観察した結果、１か月後に比較試験サンプル（エレクトレット化されていないポリプロピレンフィフルムで包装のもの）には、白いカビが発生していた。

これに対し、エレクトレット材料で包装した試験サンプルには、正極性面側で包装したものおよび負極性面側で包装したもののいずれの場合にも、２か月経過した後にもカビの発生がなく、また萎縮もなく、鮮度保持効果が顕著に認められた。

実施例２

実施例１で使用したものと同じエレクトレット材料を用いて洋菊を包装した。

ただし、包装方法は花部のみを負極性面によって覆うように包装し、茎部は水上げのため水中に浸漬しておいた。

また、比較のため、エレクトレット化されていない他は上記と同様のポリプロピレンフィルム（表面電荷密度は測定限界以下で測定不能）を用いて、同様の包装態様に包装した。

これら二つの試験サンプルの１週間後の状態を観察したところ、エレクトレット材料を用いて包装された試験サンプルの花部は、変退色，萎縮とも認められず、鮮度が良好に保持されていた。しかし、比較サンプル（エレクトレット化されていないポリプロピレンフィフルムで包装のもの）の花部は黄ばんで退色し、かつ萎んだ状態になっていた。

実施例３

表裏両面に帯電した表面電荷密度が、それぞれ正９×１０$^{-9}$クーロン／cm^2，負１×１０$^{-9}$クーロン／cm^{2}であり、炭酸ガス透過度が３０，０００～４０，０００cc／m^2.24hr.atm，酸素透過度が７，２００～１１，８００cc／m^2.24hr.atm，透湿度が２７～２９g／m^2.24hrである厚さ１２μmのポリプロピレンフィルムからなるエレクトレット材料を、その電界方向が同一となるように２枚に積層した。

この積層ポリプロピレンフィルムを包装材とし、その負極性面を雲州みかんの表面を密着させるようにして完全密封包装し、室温２０℃±２℃、湿度６５％±２％の室内に放置した。

サンプル数は２０個であり、その経日とともに変化する腐敗の状況を観察することにより、保存率Kを求めた。保存率Kは、下記のようにして求めた。

$$\text{保存率}\quad K\ (\%) = \frac{N-n}{N} \times 100$$

N：試験サンプル数

n：腐敗、カビ、乾燥などで傷みが生じたサンプル数

上記試験の結果、１カ月後の保存率は１００％、２カ月後の保存率は７０％であった。また、その多数のサンプルが外観を損なうことがなく、保存効果は非常に良好であった。

比較例１

実施例３と同じ厚さで、同じ炭酸ガス透過度、酸素透過度、透湿度を有するポリプロピレンフィルムを、エレクトレット化しないで２枚を積層した。

この積層ポリプロピレンフィルムを包装材とし、実施例３と同様に雲州みかんを包装した。サンプル数、放置条件のすべてを実施例３と同じにして同様の試験を行った。

その結果、１カ月後の保存率は６０％、２カ月後の保存率は５％であり、実施例３に比べて

保存効果は非常に悪かった。

比較例2

炭酸ガス透過度が72～105cc／㎡・24hr・atm，酸素透過度が32～40cc／㎡・24hr・atm，透湿度が2～2．5g／㎡・24hrで、厚さ10μmの市販の塩化ビニリデン系フィルムを2枚積層し、これを包装材として実施例3と同様の雲州みかんを完全密封包装した。サンプル数、放置条件のすべてを実施例3と同じにして同じ試験を行った。

その結果、1カ月後の保存率は30％、2カ月後の保存率は0％になり、すべてのサンプルが腐敗して原形をとどめていなかった。

比較例3

実施例3と同じ厚さで、炭酸ガス透過度が28，000～36，000cc／㎡・24hr・atm，酸素透過度が9，000～10，000cc／㎡・24hr・atm，透湿度が29～31g／㎡・24hrのエレクトレット化されてないポリエチレンフィルムを2枚積層し、この積層フィルムを包装材にして実施例3と同様の雲州みかんを完全密封包装した。サンプル数、放置条件のすべてを実施例3と同じにして同様な試験を行った。

その結果、1カ月後の保存率は10％、2カ月後の保存率は0％になり、すべてのサンプルが腐敗し、カビが発生していた。

比較例4

実施例3と同様の雲州ミカンを樹脂フィルムで包装することなく裸のままにし、かつサンプル数、放置条件のすべてを実施例3と同じにして同様な試験を行った。

その結果、1カ月後の保存率は10％、2カ月後の保存率は0％であり、すべてのサンプルが乾燥、収縮しており、生鮮度は全くなくなっていた。

実施例4

表裏両面に帯電した表面電荷密度が、それぞれ正9×10^{-9}クーロン／cm^2，負9×10^{-9}クーロン／cm^{2}で、炭酸ガス透過度が13，000～20，000cc／㎡・24hr・atm，酸素透過度が3，400～6，000cc／㎡・24hr・atm，透湿度が14～16g／㎡・24hrである厚さ24μmのエレクトレット化されたポリプロピレンフィルムを包装材とし、このフィルム2枚を、その負極性面同士が互いに向い合うように合わせた間にクローバーをはさみ、該クローバーから5cm離れた周囲をヒートカッターで溶融切断して空気の出入りが無いように密封した包装サンプルを多数作成した。

これを室温20℃±2℃、湿度65％±2％の室内に放置して、クローバーの色の退色や変色について試験した。

その結果、2カ月後はクローバーの葉が多少収縮したものの、葉の色は退色や変色がなく濃緑色のままであった。また、カビの発生も全くなかった。

比較例5

実施例4と同様な厚さを有し、炭酸ガス透過度、酸素透過度、透湿度も実施例4と同じエレクトレット化されてないポリプロピレンフィルムを包装材として使用して、このフィルム2枚の間に実施例4と同様のクローバーをはさみ、該クローバーから5cm離れた周囲をヒートカッターで溶融切断して空気の出入りが無いように密封包装したサンプルを多数作成した。サンプル数、放置条件の全てを実施例4と同じにして同様の試験を行った。

その結果、ほとんどのサンプルは3週間を過ぎると葉の色の退色が進み、1カ月後までには全てが茶色に変色した。また、1カ月後に40％のサンプルにカビの発生が確認された。

比較例6

炭酸ガス透過度が72～105cc／㎡・24hr・atm，酸素透過度が32～40cc／㎡・24hr・atm，透湿度が2～2．5g／㎡・24hrで、厚さ10μmの市販の塩化ビニリデン系フィルムを包装材に使用し、そのフィルム2枚の間に実施例4と同様のクローバーをはさみ、クローバーから5cm離れた周囲をヒートカッターで溶融切断して空気の出入りが無いように密封包装

したサンプルを多数作成した。サンプル数、放置条件の全てを実施例4と同じにして同様な試験を行った。

その結果、ほとんどのサンプルは2週間を過ぎると葉の色の退色が進み、3週間を過ぎると比較例5と同様に全てが茶色に変色した。また、1カ月後には100％全てのサンプルにカビの発生が確認された。

比較例7

実施例4と同じ厚さで、炭酸ガス透過度が12，000～19，000cc／㎡・24hr・atm，酸素透過度が4，000～5，000cc／㎡・24hr・atm，透湿度が15～17g／㎡・24hrのエレクトレット化されてないポリエチレンフィルムを包装材に使用し、そのフィルム2枚の間に実施例4と同様のクローバーをはさみ、クローバーから5cm離れた周囲をヒートカッターで溶融切断して空気の出入りが無いように完全密封包装されたサンプルを多数作成した。サンプル数、放置条件の全てを実施例4と同じにして同様な試験を行った。

その結果、ほとんどのサンプルは2週間を過ぎると葉の色の退色が進み、3週間後にはサンプルの50％は黄色に変色し、35％は黄土色に変色していた。また、15％は茶色に変色し、緑色を保ったのはわずか5％にしか過ぎなかった。1カ月後には25％のサンプルにカビの発生が確認された。

その他、野菜ではキュウリ、キャベツ、ホウレン草を、果物ではリンゴを、草花や生花店で売られているマーガレットや小菊の花、茎、葉などについても上述したのと同様な比較試験を行った。

その結果は、被包装物の種類によって腐敗するまでの日数に違いはあるものの、いずれの場合も本発明の包装材による保存方法の方が優れていた。

〔発明の効果〕

上述したように本発明の包装材は、エレクトレット材料が発生する電界による電気的刺激作用が、鮮度低下を抑制したり、また細菌，カビなどの生殖細胞の繁殖を抑制する効果をもたらし、被包装物を長期間にわたり元の状態に保存することができる。また、被包装物の退色や変色を少なくし、良好な外観を長期間保持することができる。

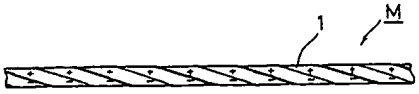
4．図面の簡単な説明

第1図は本発明の樹脂フィルムからなる包装材の一部を示す縦断面図、第2図は本発明の他の実施例からなる樹脂フィルムの積層体からなる包装材の一部を示す縦断面図、第3図は本発明のさらに他の実施例からなる樹脂フィルムと他のシート状物との複合体からなる包装材の一部を示す縦断面図、第4図は本発明のさらに他の実施例からなる樹脂成形構造体からなる包装材を示す縦断面図、第5図は本発明の包装材を使用した包装方法の例を示す説明図である。第6図は、エレクトレット材料の表面電荷密度を測定する測定機構の模式図である。

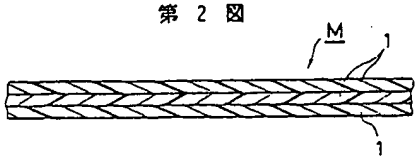
M…包装材、1…樹脂フィルム、3…成形構造体。

代理人　弁理士　小　川　信　一
弁理士　野　口　賢　照
弁理士　斎　下　和　彦

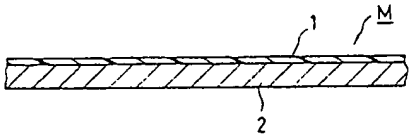
第 1 図



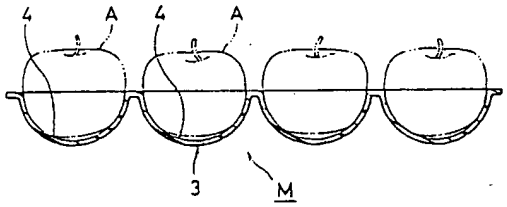
第 2 図



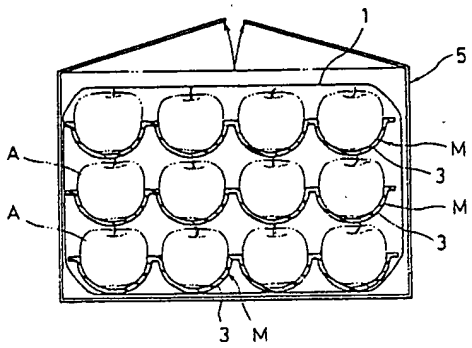
第 3 図



第 4 図



第 5 図



第 6 図